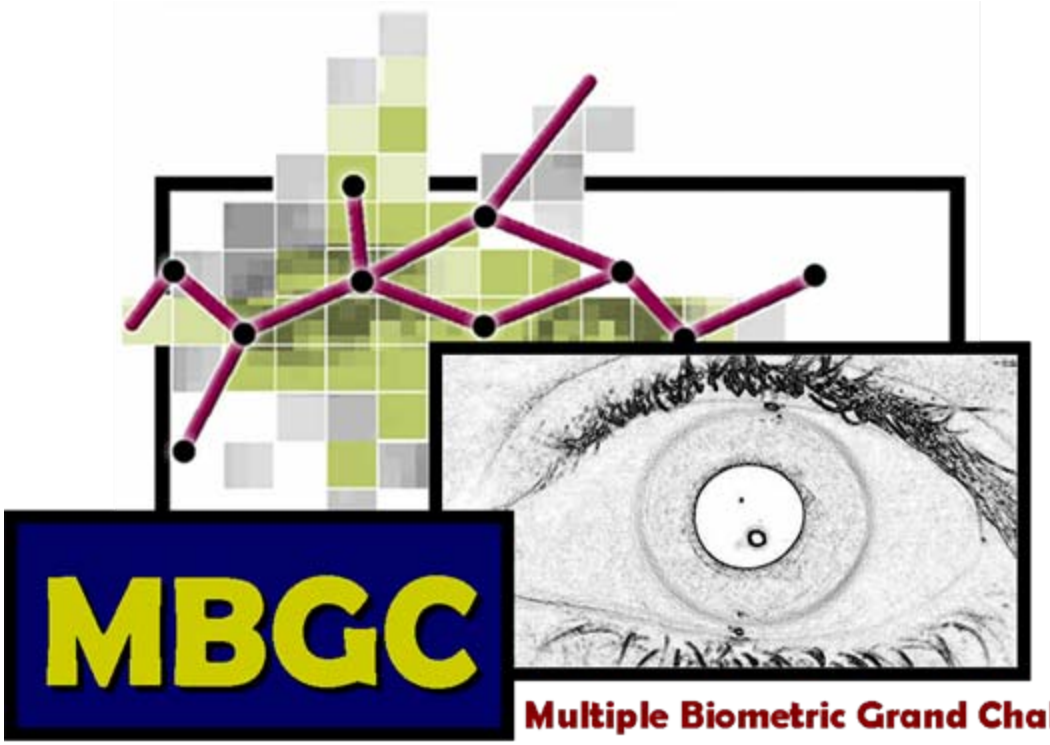


Multiple Biometric Grand Challenge Kick-Off Workshop

18 April 2008

MBGC Sponsors

Executing Agency

- National Institute of Standards and Technology — NIST
  ...working with industry to foster innovation, trade, security and jobs

Sponsoring Agencies

- BIOMETRICS TASK FORCE
- Director of National Intelligence — IARPA
  Intelligence Advanced Research Projects Activity
- Homeland Security
  - Science & Technology Directorate
- Federal Bureau of Investigation
  www.fbi.gov
  - Criminal Justice Information Services
  - Operational Technology Division
- COMBATING TERRORISM
  TSWG
  TECHNICAL SUPPORT WORKING GROUP

The MBGC Team

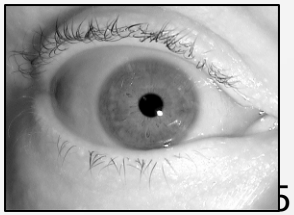
- NIST
  - P. Jonathon Phillips, Test Director
  - Elaine Newton
- Colorado State University
  - Ross Beveridge & Geoff Givens
- SAIC
  - Todd Scruggs
- Schafer Corporation
  - Cathy Schott
- University of Notre Dame
  - Kevin Bowyer & Patrick Flynn
- University of Texas at Dallas
  - Alice O'Toole

Overview

- Background
- MBGC Overview
  - MBGC Goal
  - MBGC Structure
  - Challenge Problem Descriptions
  - How to get the MBGC Data

Challenge Problems

- What are challenge problems?
  - A series of experiments designed to advance a technology's state-of-the-art
    - Experiments designed
    - Experiments and test data distributed to researchers
    - Researchers complete experiments and submit results
    - Scores are consolidated and reported
  - Introduction of new technology
    - Specific to MBGC



Challenge Problem

- What is provided to participants
  - Data (biometric samples)
  - Ground truth (subject ids)
  - Experiment description
  - Score code
  - Standard results format
- What is requested from participants
  - Submission of results

New Technology Development

- Very high resolution Near Infrared (NIR) portal sequences
- Iris video
- Fusion of multi-modal video
- Unconstrained face recognition
- Realistic mug shot and passport images

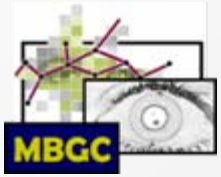
What to Expect from the MBGC

- MBGC will determine performance improvement on face and iris recognition

- Results will measure:
  - Improvement obtained from video
  - If more samples of existing mode improve performance
  - Effect of resolution on still face
  - Improvement obtained through fusion of face and iris

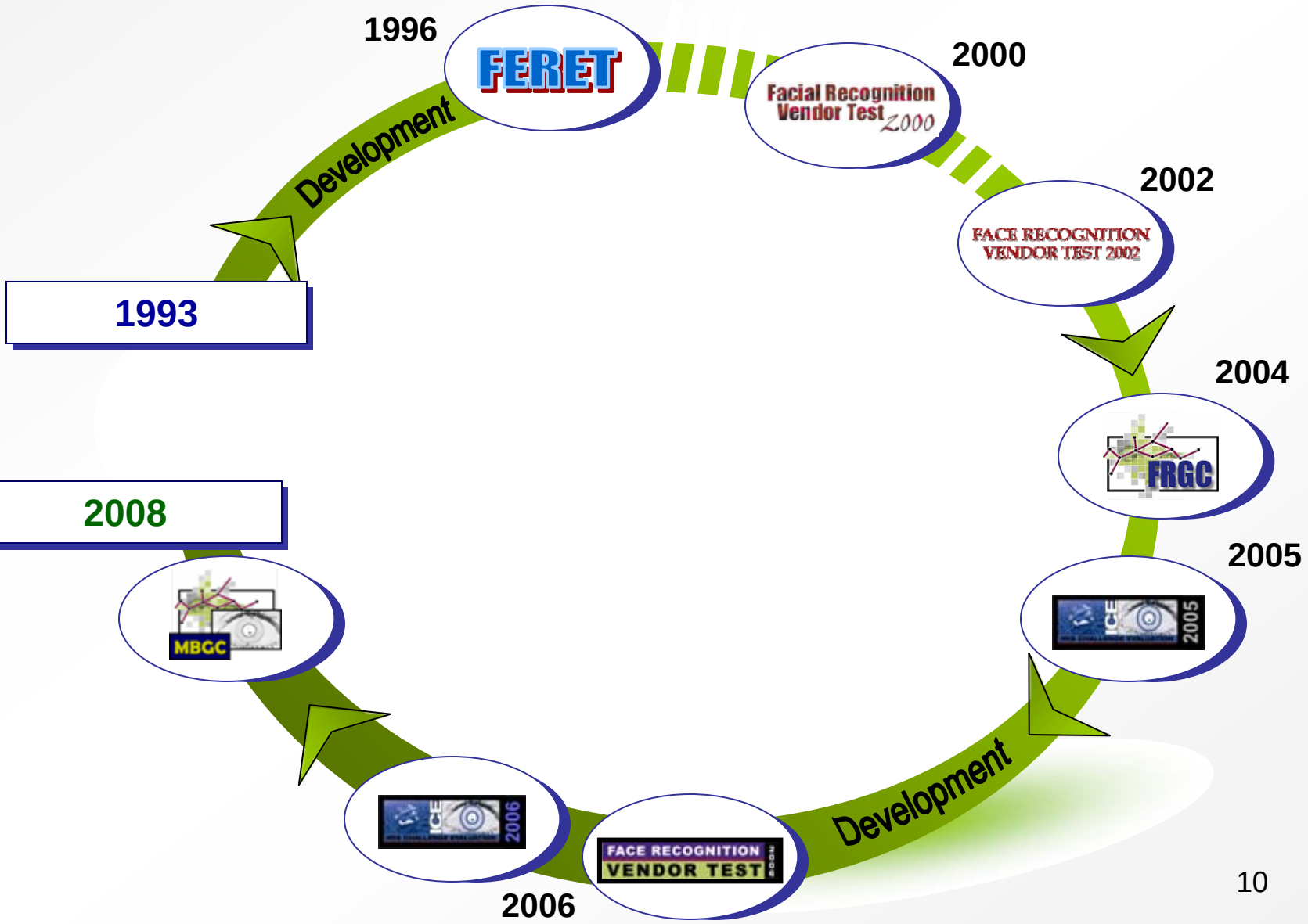
Background

- FERET 1993-1997
  - Army Research Lab challenge problem/evaluation
- Face Recognition Vendor Test (FRVT) 2000
  - DARPA, NIST, DoD CTDP and NIJ Evaluation
- FRVT 2002
  - DARPA, NIST and DoD CTDP Evaluation
- HumanID Gait Challenge 2002-2003
  - DARPA Challenge problem
- Face Recognition Grand Challenge 2004-2006
  - NIST directed challenge problem
- FRVT 2006
  - NIST directed evaluation
- Iris Challenge Evaluation (ICE) 2005-2006
  - NIST directed challenge problem and evaluation
- Multiple Biometrics Grand Challenge (MBGC) 2008
  - NIST directed challenge problem

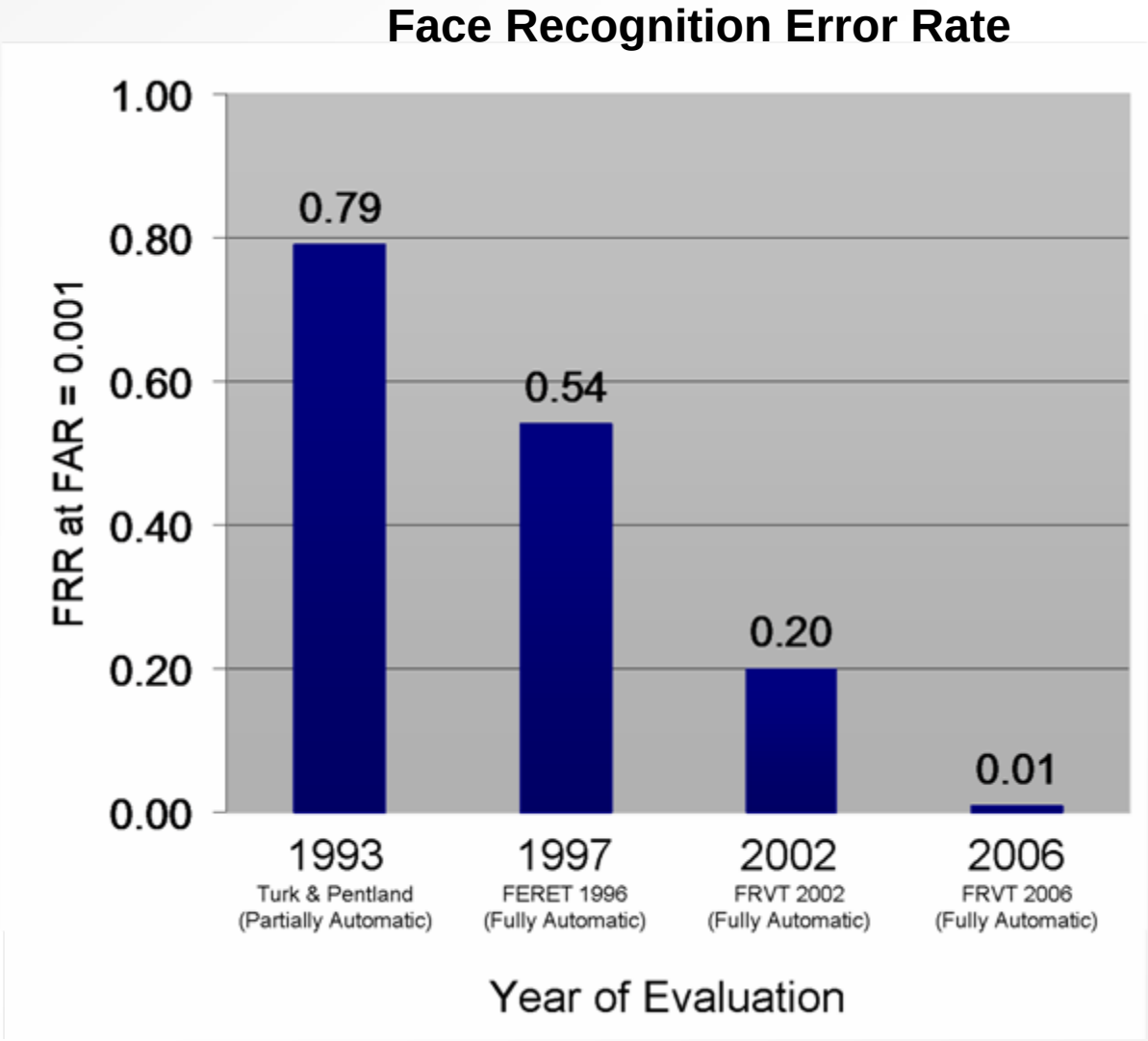


NIST

Technology Progress



Improved FR Performance



Single Still

Controlled

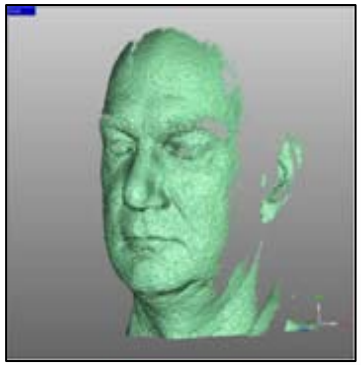
Different Days

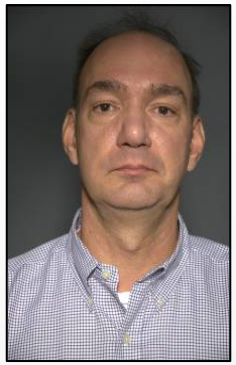
Iris Recognition

- ICE 2005 and 2006
  - First challenge problem and independent technology evaluation on multiple algorithms
  - Provided performance baseline
  - Patent expiration allowed broader technology development

What does progress mean?

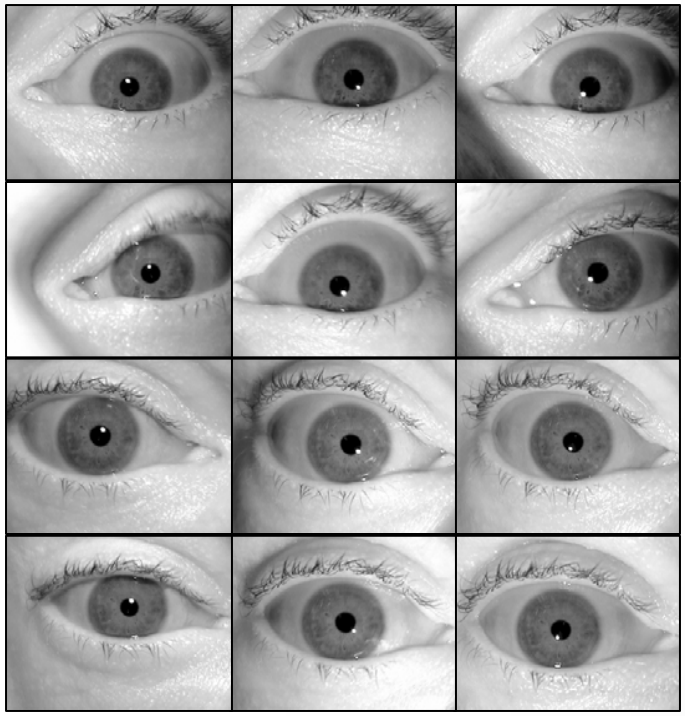
- FERET, FRGC and FRVT 2006
  - Controlled images:



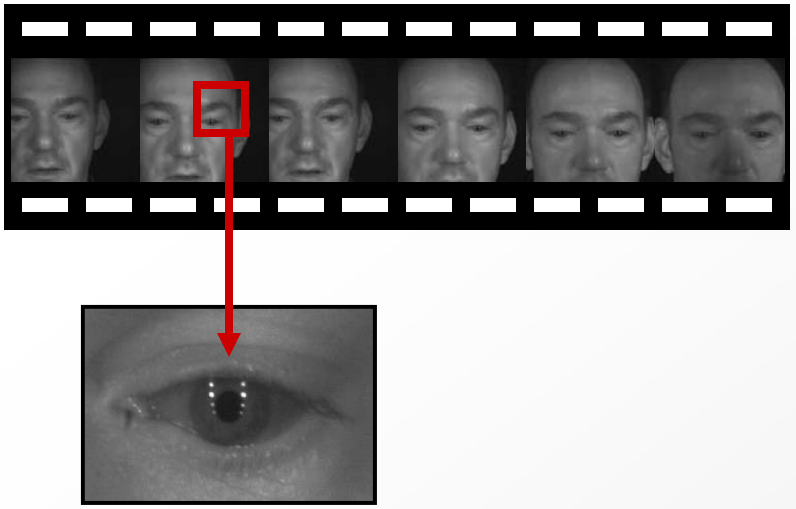


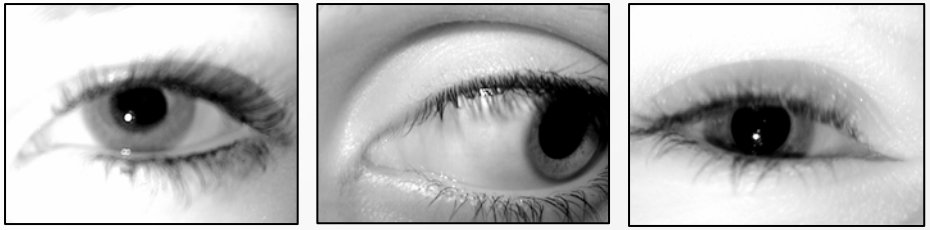
What about iris recognition?

- ICE 2006 images



- MBGC type images

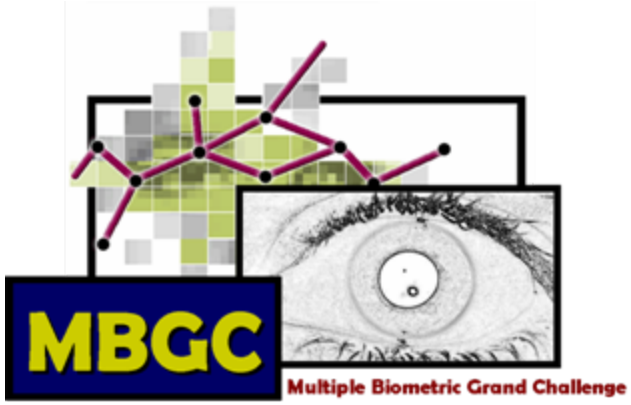




What about these images?

- MBGC plans to address these types of images:

Multiple Biometric Grand Challenge



MBGC Goal

- The main goal of the Multiple Biometric Grand Challenge (MBGC) is to
  - **Address face and iris recognition problems that are more relevant to those found in operational data**
    - **Low to medium resolution face**
    - **Still and video iris**
    - **Near Infrared (NIR) & High Definition (HD) video from portals**
    - **Unconstrained face recognition from still & video**

MBGC Goal

- Programmatic Method
  - **Sequence of challenge problems**
    - **Modeled after the FRGC and ICE 2005**
    - **Challenge problems and data distributed to researchers**
  - **Workshops**
  - **Planned independent technology evaluation**

Timeline

- Estimated Task Schedule for MBGC:

Estimated Schedule	Task
December 2007	Formal annoucement of MBGC project Begin data collection at University of Notre Dame Design protocols, challenge problems and prepare test infrastructure
April/May 2008	1st MBGC Workshop Release 1st challenge problem
October 2008	2nd MBGC Workshop Self-reported results on Challenge Problem 1 presented Release 2nd Challenge Problem
Spring 2009	3rd MBGC Workshop Self-reported results on Challenge Problem 2 presented
Spring/Summer 2009	Planned Multi-Biometric Evaluation (MBE) 2009 (Option)

MBGC Challenge Problems

Worked with sponsors over a 12-month period to define problems

Portal Video

Video Face

Still Face

Mugshot

ICAO-ISO Standard

Portal Challenge Problem

Portal Video

Mugshot

ICAO-ISO Standard

Motivations

- Rapid acquisition of biometrics at points of entry
- Non-invasive capture

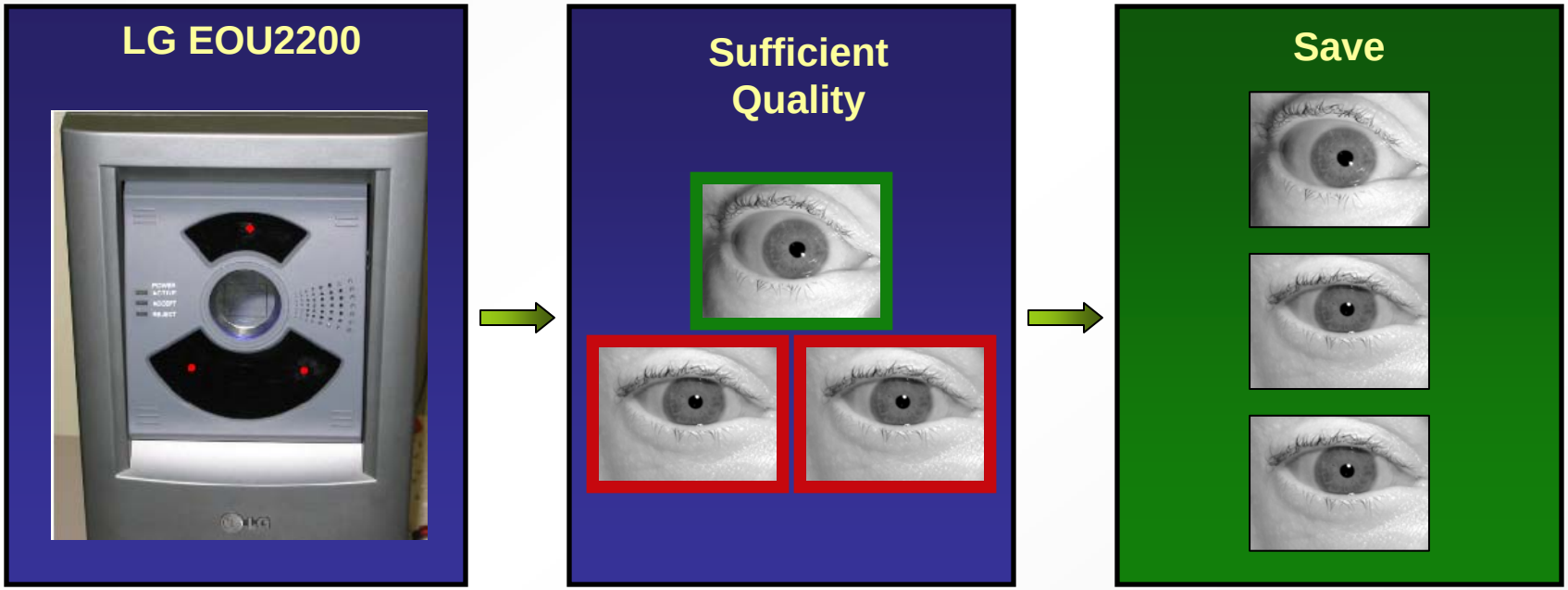
Portal Goals

- Algorithm development
  - Biometrics: face and iris
  - Modes: iris video, NIR video, HD video

Meet the Sensors….

Meet the LG 2200

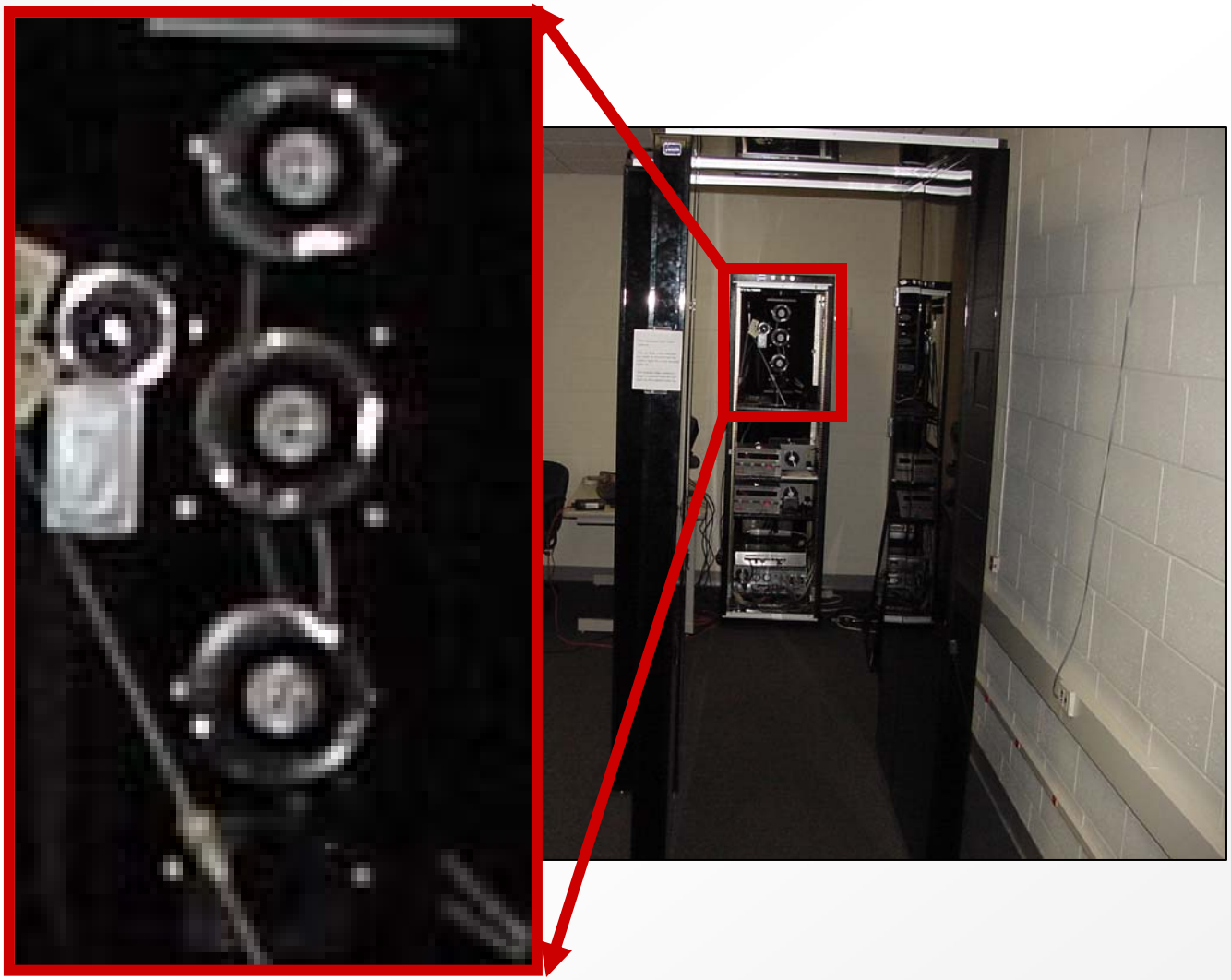
MBGC Iris Acquisition System



- Take 3 iris images
- One above quality threshold
- Save all three

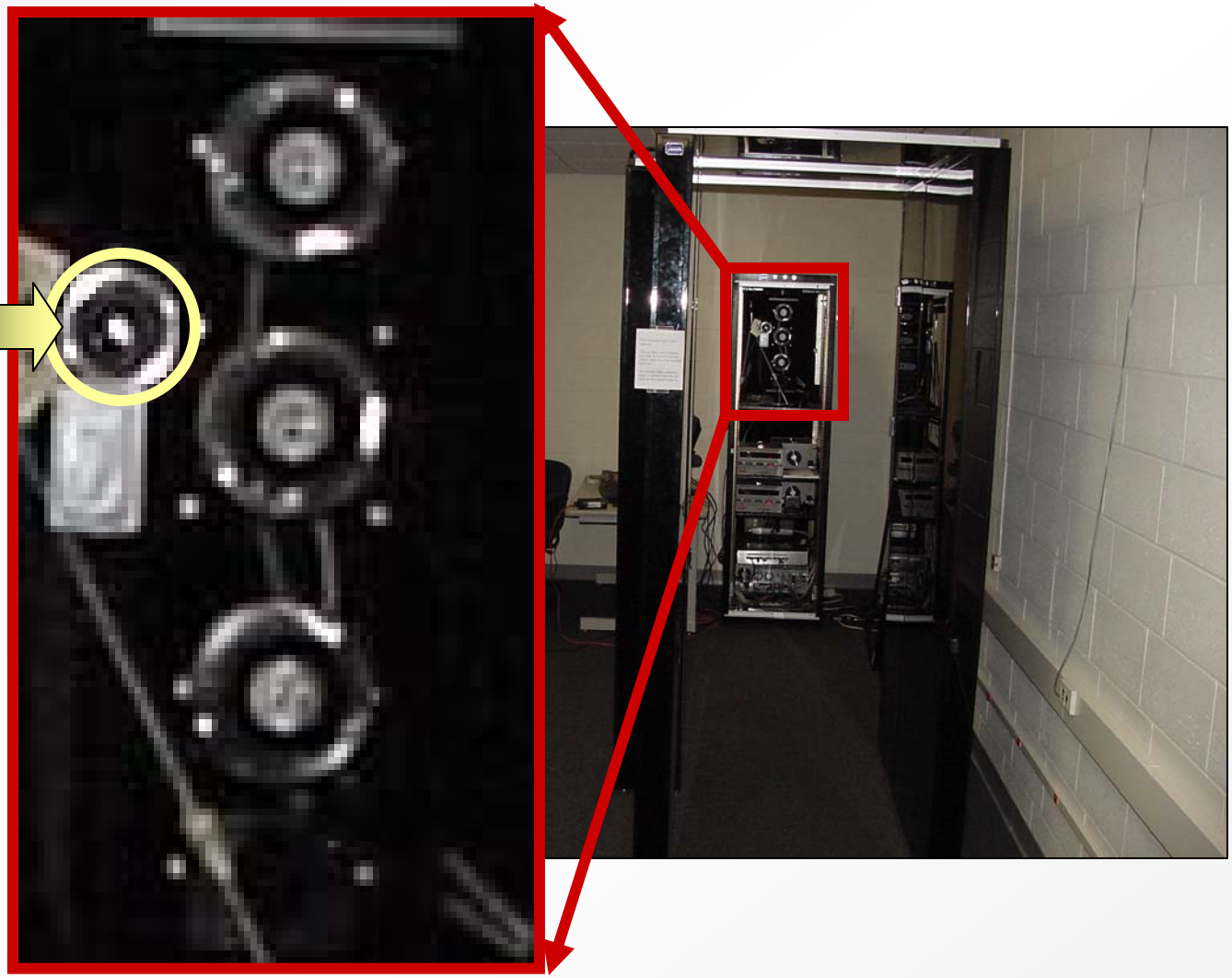
Meet the Portal

Meet the Portal



Meet the Portal

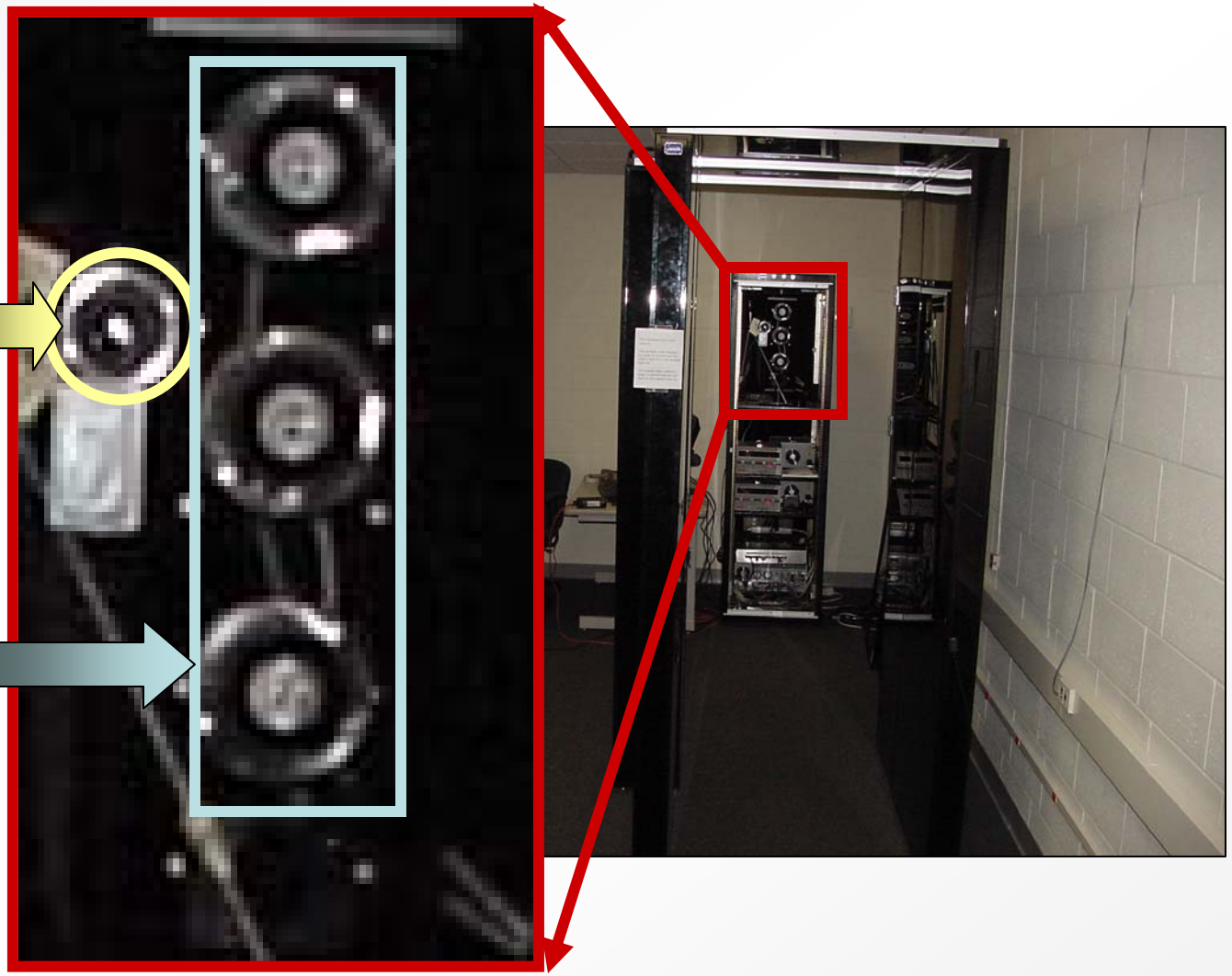
High Definition (HD) Video Camera



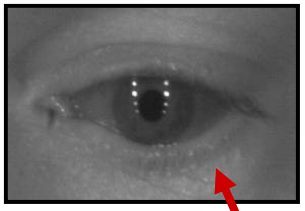
Meet the Portal

High Definition (HD) Video Camera

Near Infrared (NIR) Video Cameras



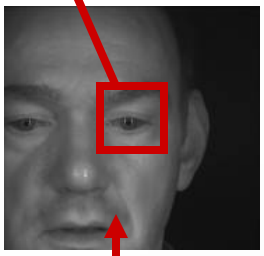
Meet the Portal



120 pixels
across iris

2k

2k

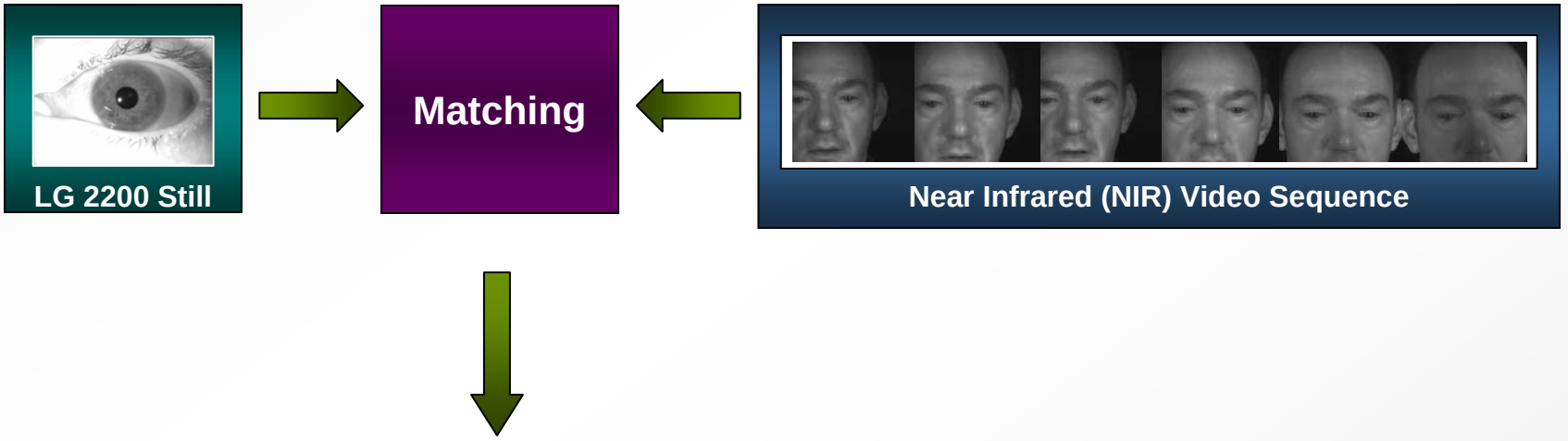


Near Infrared (NIR) Video Sequence

Experiment Terminology

- Target
  - Enrolled image
- Query
  - Image to be recognized

Experiment:
Still Iris versus NIR



Target

Query

Experiment:
Still Iris versus NIR

Ground truth provided: Subject ID

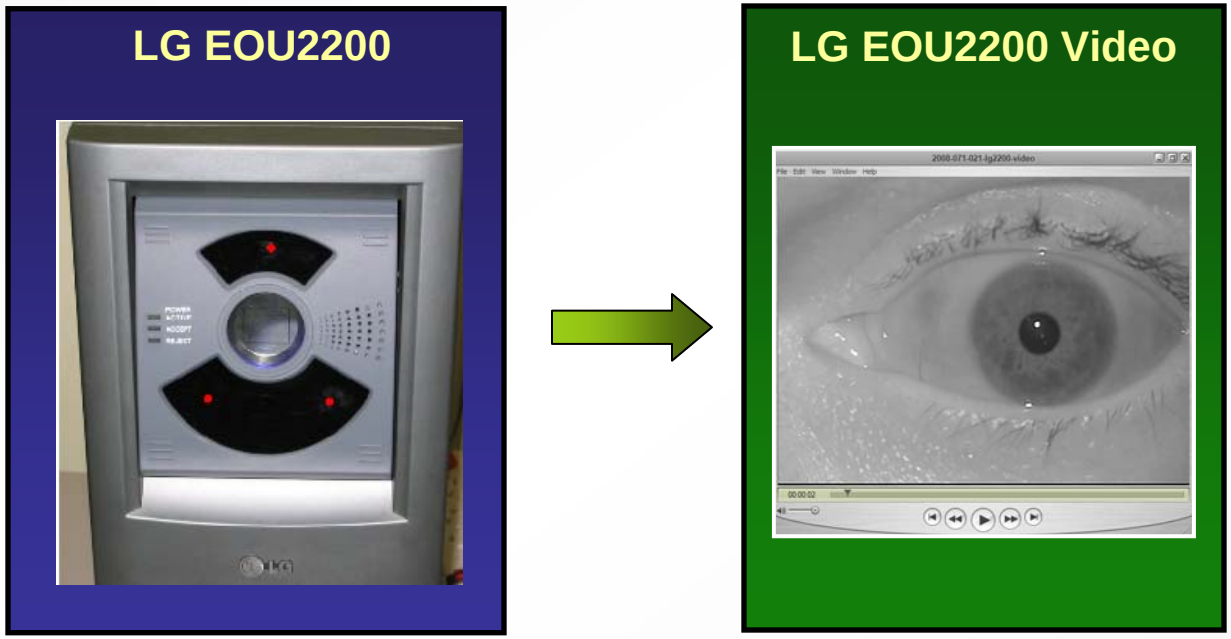
Note: Input will be full video sequence

Similarity Score

- **Algorithm will need to:**
  - **Process Video**
  - **Locate Irises**
  - **Segment Irises**
  - **Generate Template or other Representation**

Target **Query**

Meet the LG 2200 again….



Iris Video Sequence

Experiment:
Video Iris versus NIR

Similarity Score

Target Query

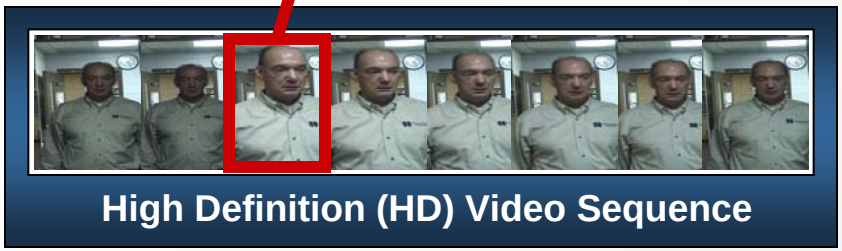
Experiment:
Video Iris versus NIR

Both inputs will be full video sequences

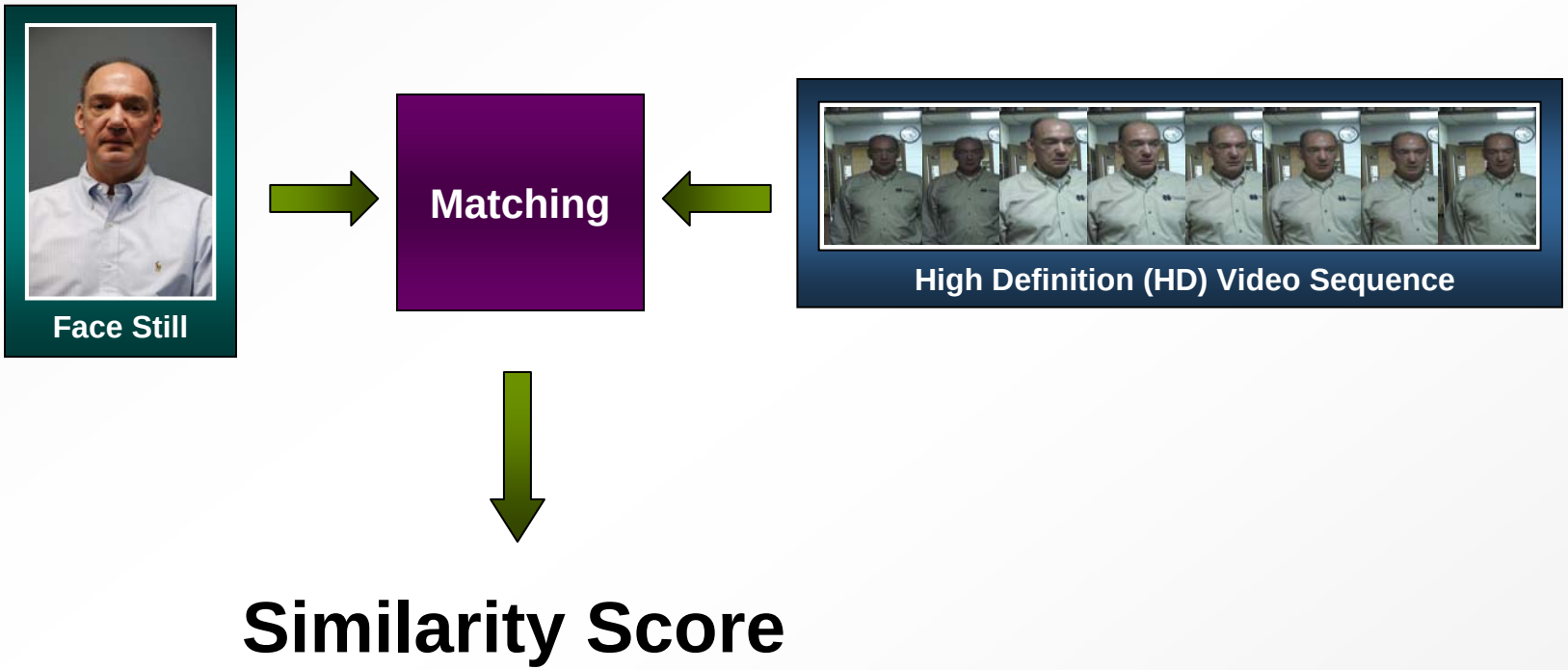
- **Algorithms will need to:**
  - **Process Video**
  - **Locate Irises**
  - **Segment Irises**
  - **Generate Templates or other Representation**

Target

Meet the Portal again….



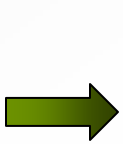
Experiment:
Still Face versus HD Video Face



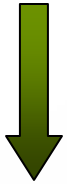
Target

Query

Experiment:
Multiple Biometrics



Matching



Similarity Score

Target Query

Experiment:
Multiple Biometrics

Input is iris video sequence and face still

Input is both video sequences

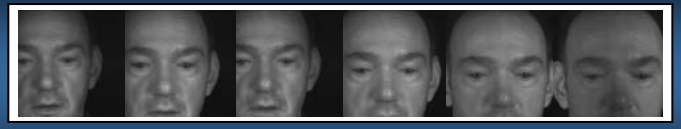
- **Algorithms will need to:**
  - **Process all video sequences**
  - **Generate templates or other representation**
  - **Decide fusion strategy**

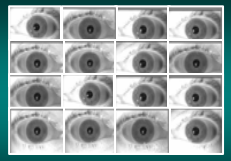
Target **Query**

Quick Summary

LG 2200 Still

Still Iris versus NIR


Near Infrared (NIR) Video Sequence


LG 2200 Video

Video Iris versus NIR

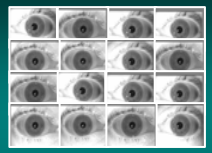
Near Infrared (NIR) Video Sequence

Face Still

Still Face versus HD Video Face

High Definition (HD) Video Sequence

Face Still


LG 2200 Video

Multiple Biometrics

Near Infrared (NIR) Still

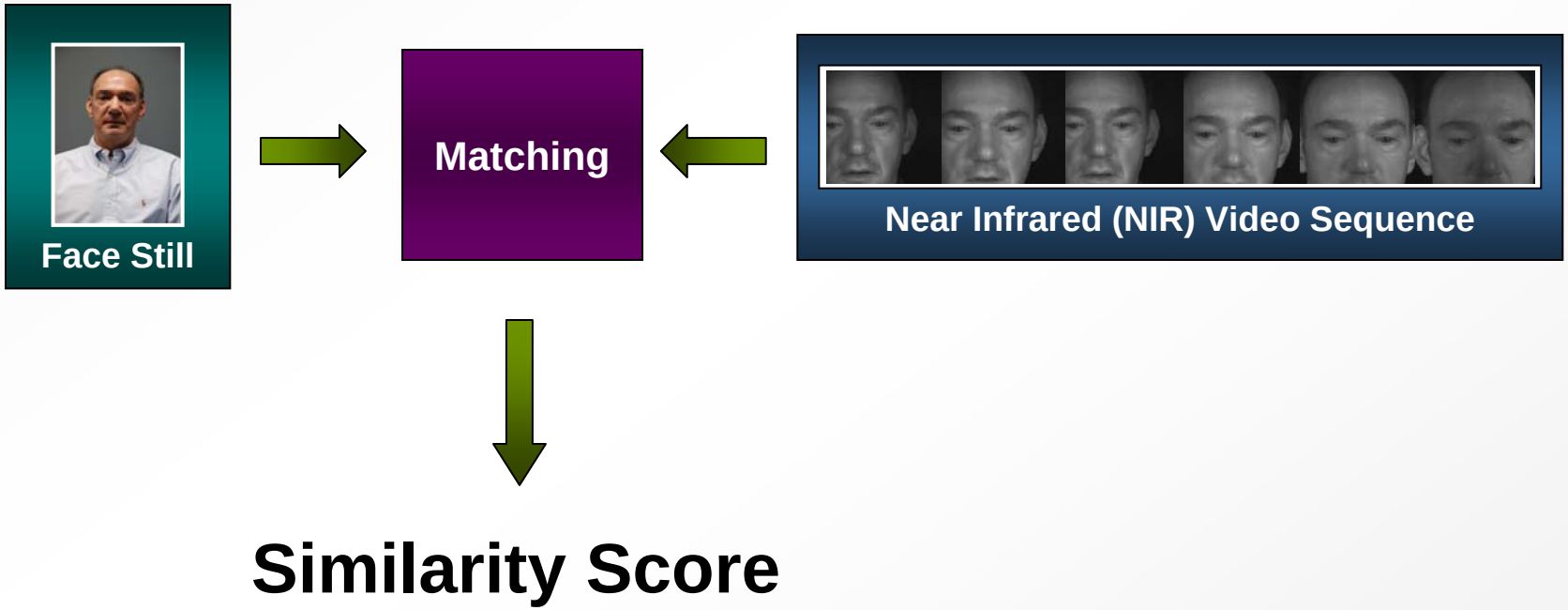
High Definition (HD) Video

Target

Query

Considerations you may not have thought of……

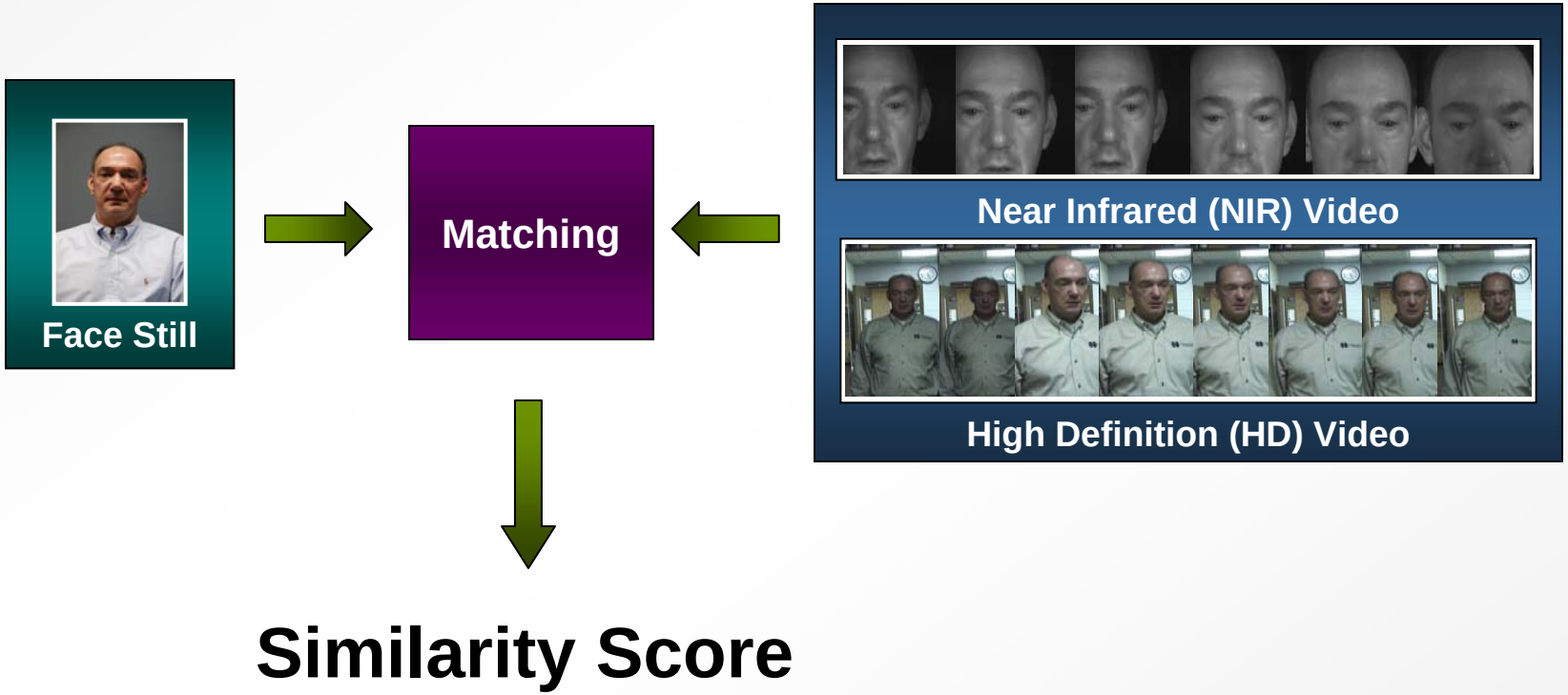
Experiment:
Cross-Mode Face



Target

Query

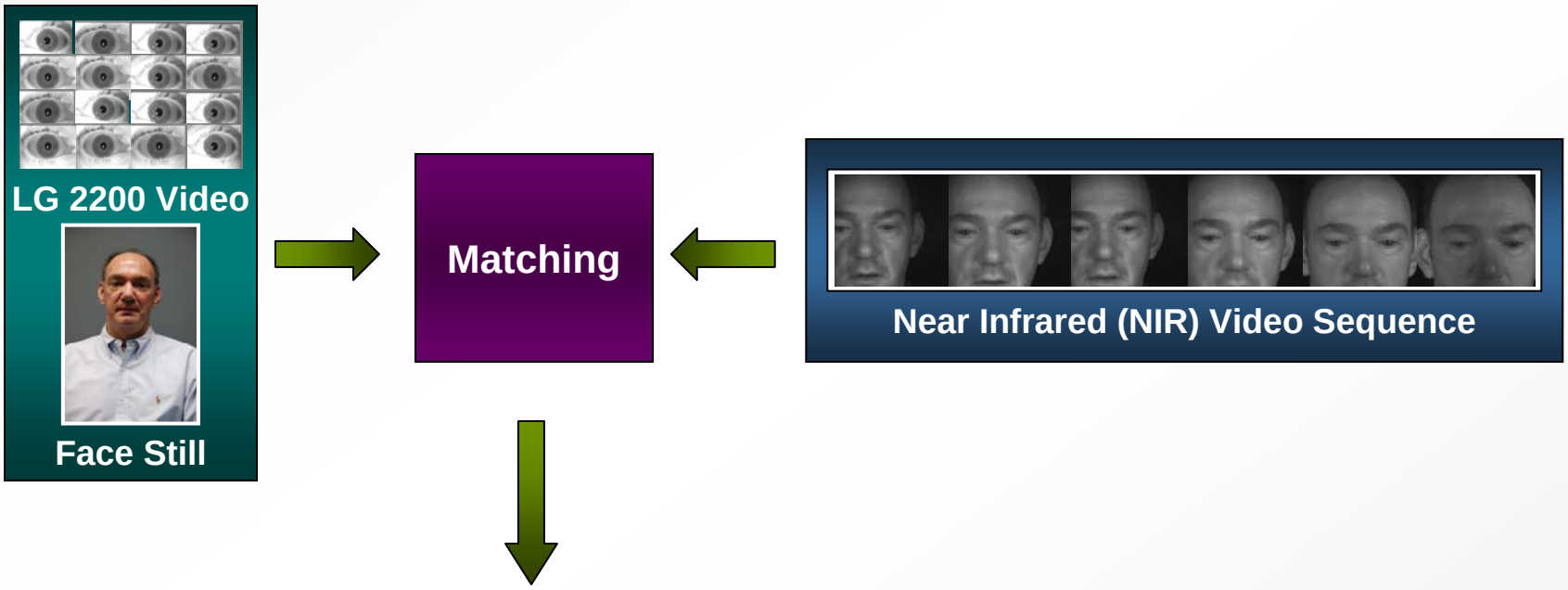
Experiment:
Multi-Mode Face



Target

Query

Experiment:
Multi-Mode Face



Target

Query

Portal Summary

- Introduce new technology
- Seven experiments
- Multiple biometrics
- Assess impact of fusion

Still Face Challenge Problem

Still Face

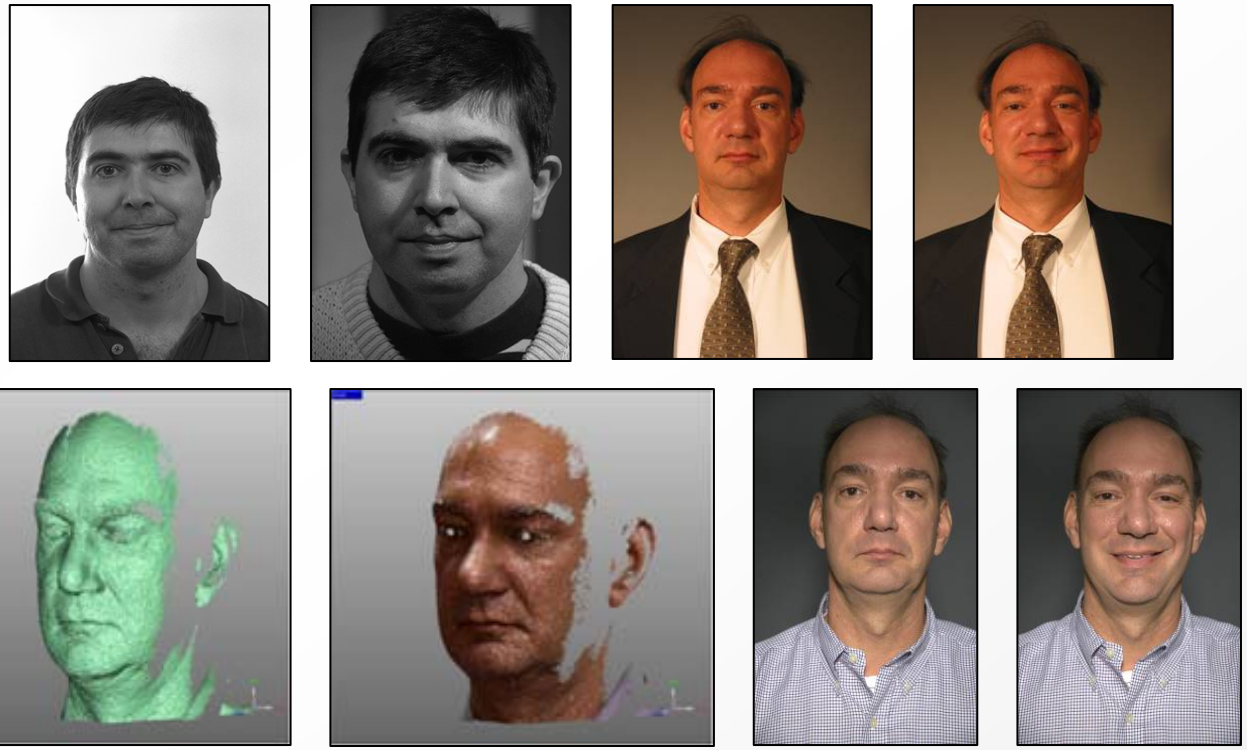
Mugshot

ICAO-ISO Standard

Standard

Frontal Face

- FERET, FRGC and FRVT 2006
  - Controlled images:

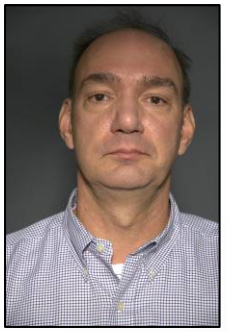


Frontal Still Face

- Unconstrained Illumination:
  - High resolution camera
    - 4 and 6 megapixels
- Images for mug shots, passports and credential cards
  - Face size 90-120 pixels between the eyes compressed to 8k and 20k
    - ISO/IEC Standard

Still Face

- Two target sets – AY03-04 (FRGC)
  - Controlled Illumination Frontal
    - 16,028 images
  - Uncontrolled Illumination Frontal
    - 8,014 images
- One query set – AY04-05
  - Uncontrolled Illumination Frontal
    - 13,785 images
      - Outdoors
      - Hallways and Atriums



Experiment:
Still Face versus Still Face

Target Set

Face Still

Query Set

Uncontrolled Face Still

Uncontrolled Face Still

Target Set

Uncontrolled Face Still

Uncontrolled Face Still

Query Set

Uncontrolled Face Still

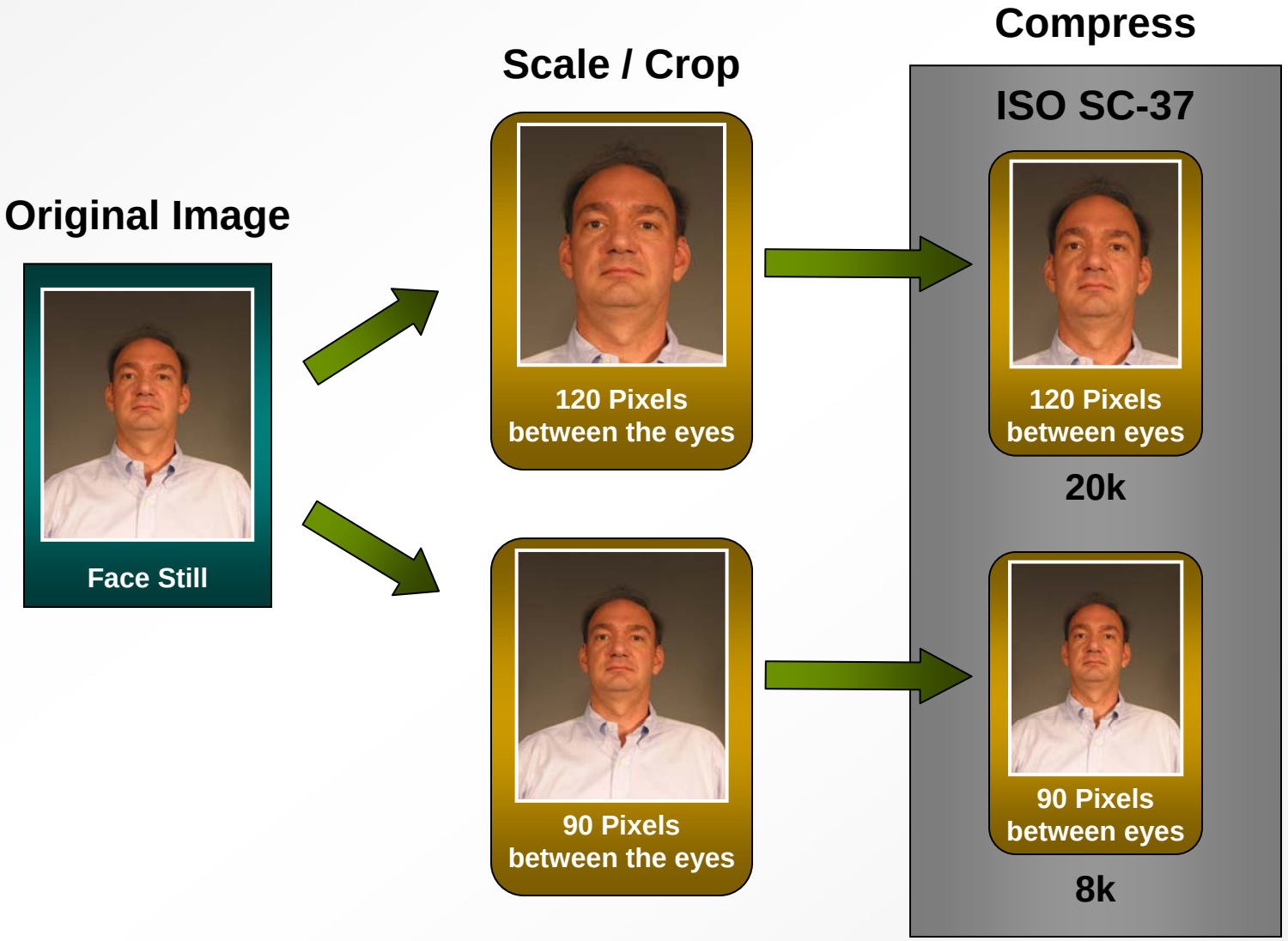
Uncontrolled Face Still

Target Query

Effects of Lower Resolution and Compression on FR

- Determine effect of
  - Lower resolution
  - Compression
- Process original images to meet data requirements
  - Scale and crop
    - 120 and 90 pixels between the eyes
  - Compress images
    - 20k and 8k

Still Face Processing

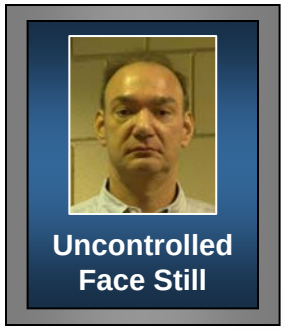


Experiment:
Still Face Compression 1

Compressed: 120 pixels between eyes, 20k

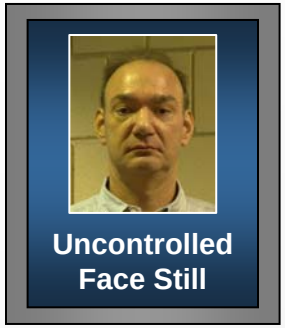
Target Set

Query Set



Target Set

Query Set



Target Query Compressed

Experiment:
Still Face Compression 2

Compressed: 90 pixels between eyes, 8k

Target Set

Query Set

Target Set

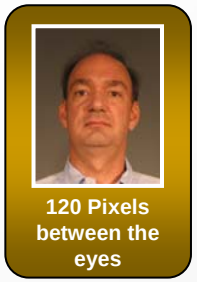
Query Set

Target Query Compressed

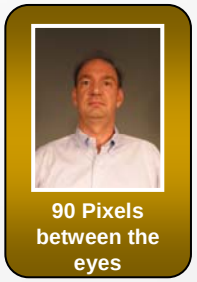
Still Face Summary

- Varying illumination
- Measure effects of compression and resolution
- Three experiments
  - High resolution
  - Two scaled and compressed

Original



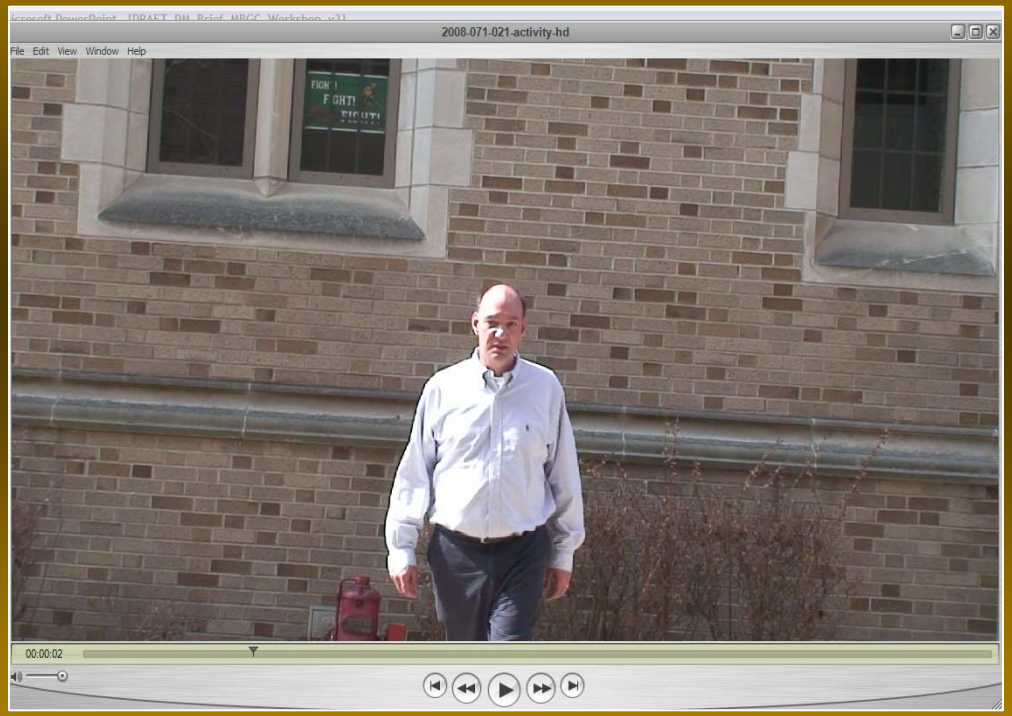
20k



8k

Video Face Challenge Problem

Video Face

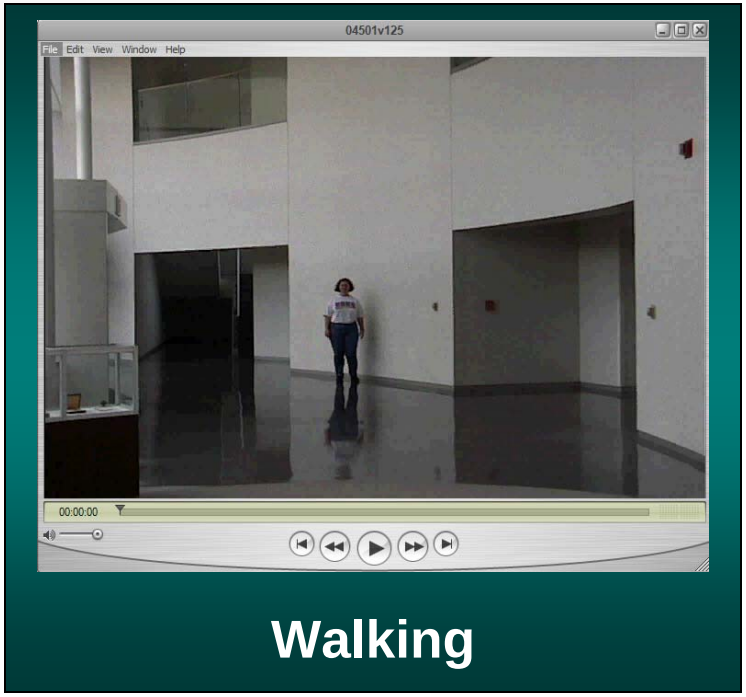


ISO
Standard

Goal and Motivition

- Unconstrained face recognition
  - Still versus video
  - Video versus video

Experiment:
Video versus Video



Target Query

Experiment:
Still versus Video

Uncontrolled Face Still

Face Video

Target

Query

Video Summary

- Video to video
- Addressing unconstrained face recognition

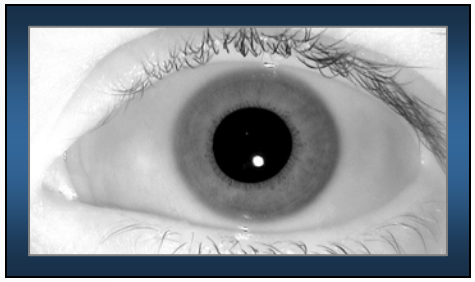
Quality

Motivations

- Ensure control over enrollment processes
  - Do you get images that give you good matches?
- Confidence level in matching for degraded images
  - Reliability in producing a good match
  - What consitutes a good quality measure?

Compute Image Quality
Still Images

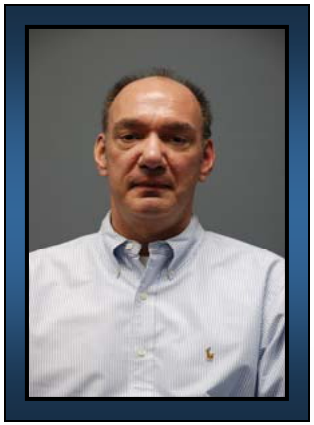
Input Iris Image



Performer's Image Quality Module

Quality Measure

Input Face Image



Performer's Image Quality Module

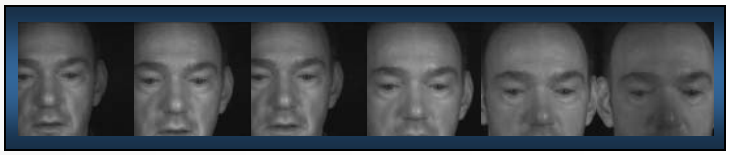
Quality Measure

Image Quality

- Optional submission
- Quality score per biometric sample

Compute Image Quality
Video

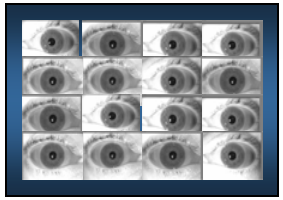
Input NIR



Performer's Image Quality Module

Quality Measure

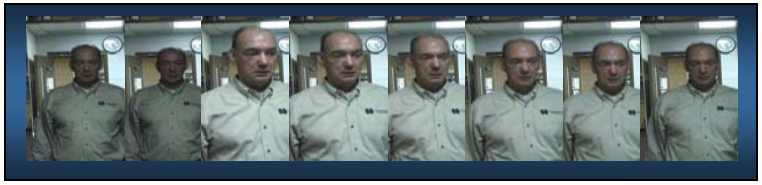
Input Iris video



Performer's Image Quality Module

Quality Measure

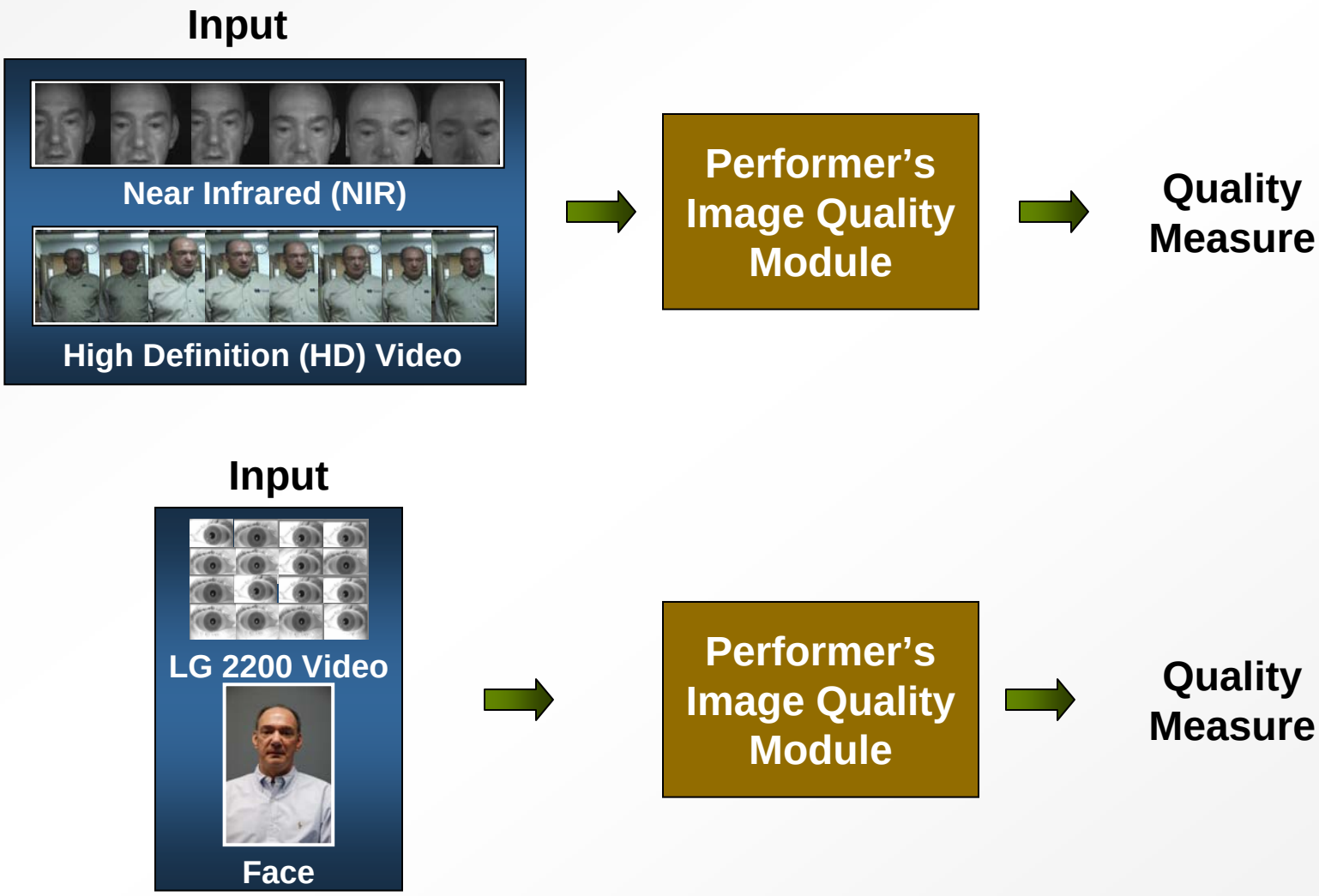
Input HD Video



Performer's Image Quality Module

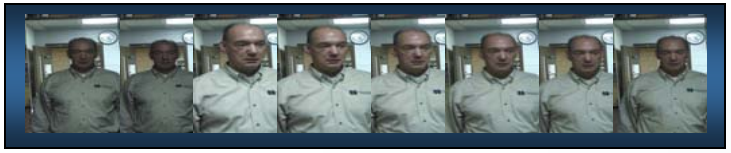
Quality Measure

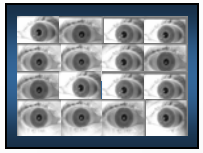
Compute Image Quality
Multi-Modal

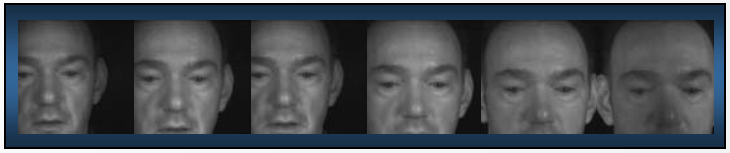


Quality Summary

- Optional part of MBGC
- Assessment of quality measures
- Impact on fusion







MBGC Mechanics

Timeline

- Estimated Task Schedule for MBGC:

Estimated Schedule	Task
December 2007	Formal annoucement of MBGC project Begin data collection at University of Notre Dame Design protocols, challenge problems and prepare test infrastructure
April/May 2008	1st MBGC Workshop Release 1st challenge problem
October 2008	2nd MBGC Workshop Self-reported results on Challenge Problem 1 presented Release 2nd Challenge Problem
Spring 2009	3rd MBGC Workshop Self-reported results on Challenge Problem 2 presented
Spring/Summer 2009	Planned Multi-Biometric Evaluation (MBE) 2009 (Option)

What is provided by us….

- Challenge problem data
- Subject IDs
- XML sigset description
- Common results format
- Classes to read/write formats
- Scoring code
- Bash script for running experiments
  - Same arguments as FRVT 2006 & ICE 2006

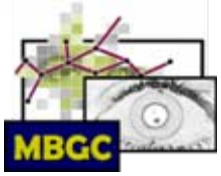
General Rules for Submitting

- Submit
  - Matching results (Similarity matrix)
  - Quality scores [optional]
- Can submit subset of experiments
- NIST reserves right to attribute performance

Challenge Problems and Data Distribution

- Challenge problems and the first MBGC data set will be released sequentially starting **1 May 2008**
- To obtain data, you will need to submit data licenses signed by proper legal authorities
- Instructions for requests will be posted on MBGC website at http://face.nist.gov/mbgc

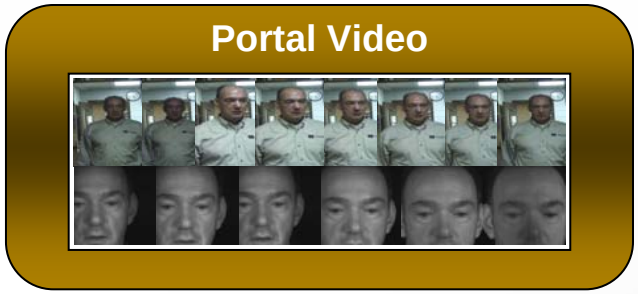
Estimated Size of Challenge Problems



- Portal
  - 600 video sequences
  - 1400 stills
  - 100 Gigabytes
- Still face
  - 150,000 stills
  - 75 Gigabytes
- Video face
  - 1500 video sequences
  - 1500 stills
  - 150 Gigabytes

Challenge Problems and Data Distribution

- What is the method of distribution?
  - Downloadable via rsync
  - Instructions for downloading data will be distributed after
    - Data licenses have been properly signed and submitted and your request has been processed

Summary

- Multiple Biometric Grand Challenge (MBGC)
- Three challenge problems
- Multiple biometrics for portals
- Towards unconstrained face recognition